Asia Renewables

Biomass Supply Optimization

Taking biomass to the next level: Adjusting to the fuel supply challenge

1. **Considerations in "Traditional Biomass Projects"**
2. **Fuel Security Strategies and Approaches**
3. **Adding a Shipping Component**
4. **Building on the Shipping Component**

ASIA RENEWABLES PTE. LTD.

www.asiarenewables.org

Asia Renewables is a clean energy company focusing on investment in, and end-to-end development of, replicable renewable energy, carbon abatement and sustainable development assets in emerging markets.

Asia Renewables is currently engaged in the development of several biomass to energy plants, development of geothermal, and solar projects in China, India, Thailand and Indonesia.

Highly experienced development teams based in Singapore and Beijing with a project office in Chennai.

- Proven track record of development, operation and investment in landfill-gas, biomass/biogas, geothermal, hydro and solar projects.
- Critical deal capacity in Chinese, Japanese, Korean, Indonesian and Tamil.
- Well established industry and government relationships.

1. Considerations in Traditional Biomass Projects

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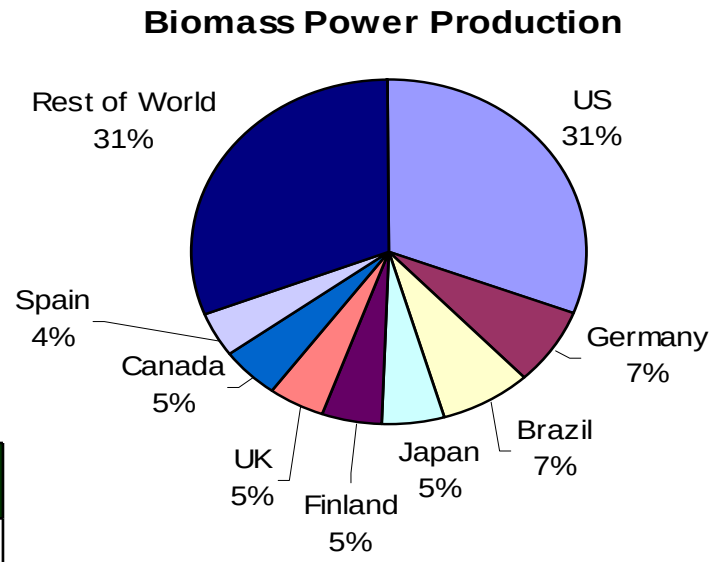
- **4. Building on the Shipping Component**
- **5. Final Comments**

1. Landscape

Global biomass electricity capacity : 47 GW

7% of total Renewable Energy (RE) investment Asia

- – Strong economic growth and power demand
- – Abundant resources: > 30% of the world's total
- – Governments have ambitious targets
- – Large untapped potential



Countries	Utilization	Potential
ASEAN	**3,000 MW**	56,000 MW
China	**2,200 MW**	24,000 MW

China

Opportunities

Rich in biomass resources:
Target - 5.5GW by 2010; 30GW by 2020
Favorable subsidy (Benchmark tariff of coal-fired power + $0.0366/kWh), Availability of local financing and mature domestic technology

Considerations

Heavily "relationship driven"
"51-49" ownership
Difficulties in incentive policies implementation: No fixed electricity off-take price

ASEAN

Opportunities

Agriculture-based economy and multi harvest - 108 mil tons/yr
Support from the Government: Feed-in tariff, PPA and tax
Indonesia: Outer Island Opportunity
Thailand: Additional $ 0.09/kWh adder for 7 years

Considerations

Indonesia: No foreign ownership of power plants <10MW
Lack of local knowledge about opportunities and project implementation
Different working standards for safety, environmental etc - not imposing too much foreign working practices on to locals

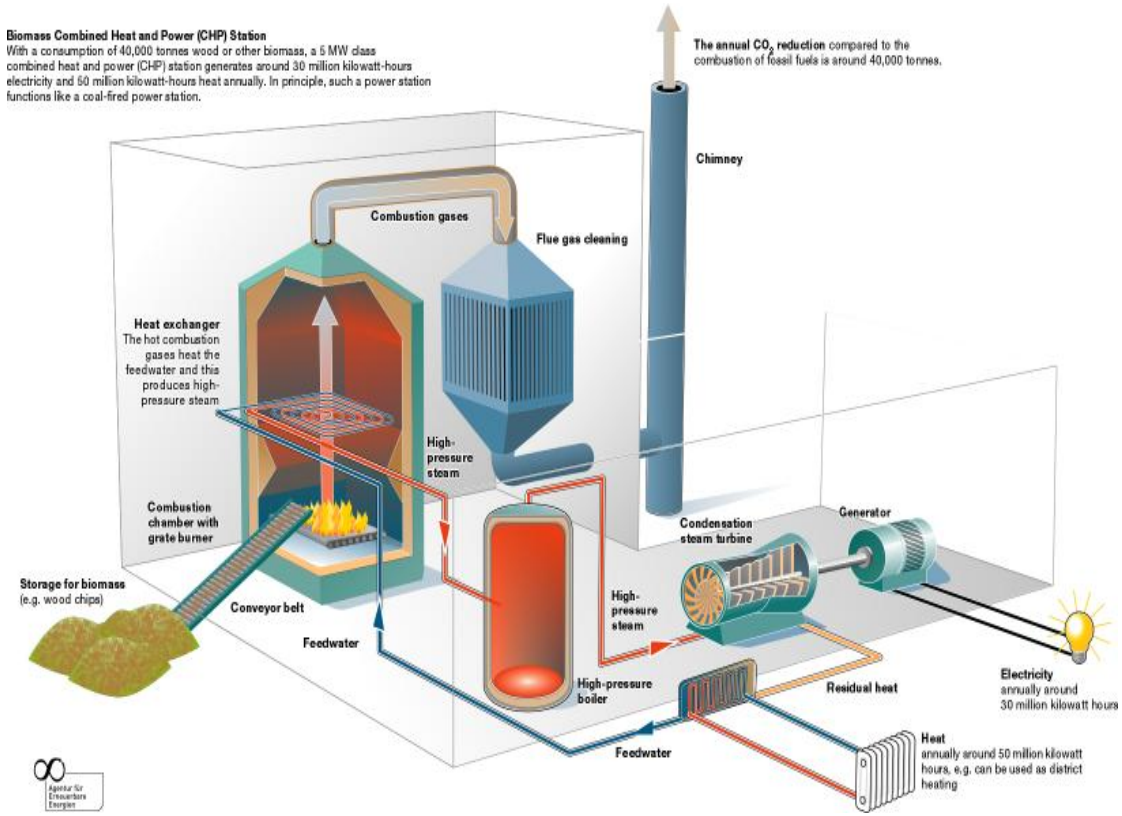
Introduction to Biomass Power Plants

Biomass combustion is one of the oldest and simplest form of energy production.

It is considered renewable and carbon neutral.

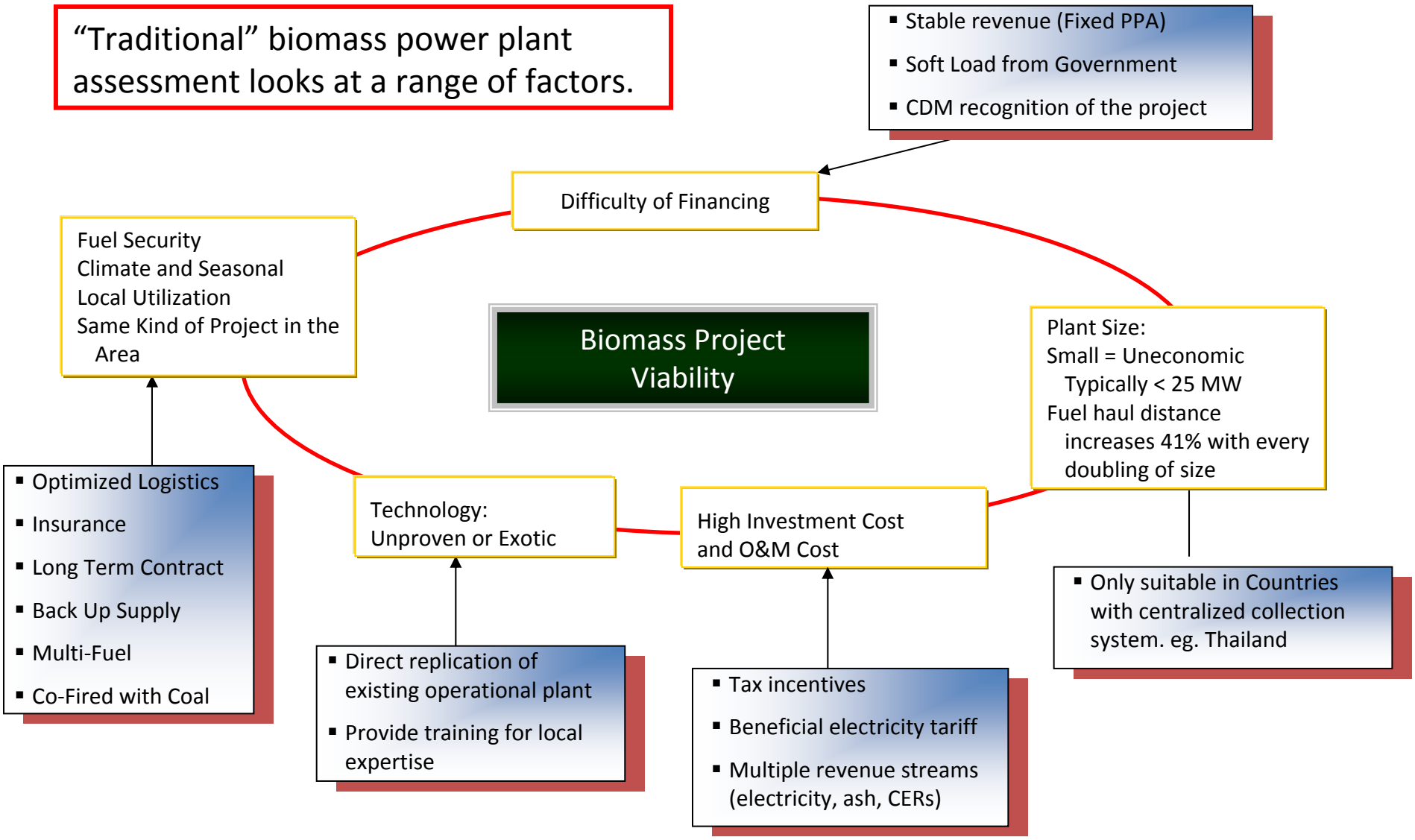
There are may types of biomass-fired power plants including simple combustion, gasification, plasma, etc.

Cheapest and most straightforward and most robust is simple combustion with multi-fuel and a larger boiler to handle more moisture.



Practical "Choke Issues"

"Traditional" biomass power plant assessment looks at a range of factors.



Sample Illustrative Project

Greenfield – 12MW Power Plant

Fuel Source – Coconut residue
Fuel source on project site, fully owned by project owner
Technology – circulating fluidized bed boiler
Location - Accessibility of the Site
Raw water : quantity, quality, cost
Ash disposal or sale
Transmission line and connection to grid
Preferential offtake adder

Financial Projections & Metrics	
Total CAPEX	US$ 20 mil
Post –Tax NPV@12%	US$430,000
Post –Tax IRR	20+%
Average annual electricity revenue	US$ 7 mil
Average annual CERs	50,000

Fuel Source – Coconut residue
Fuel source on project site, fully owned by project owner
No alternative uses for coconut residue

Yearly Fuel Amount Required: 120,000 tonnes of biomass @ 4000 Kcal/kg

Comparision, for 12 MW coal plant, need 80,000 tonnes @6000 kcal/kg

2. Fuel Security Strategies and Approaches

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Focus on Biomass Fuel Supply

The most critical aspects of biomass power plant are the source of biomass fuel and the robust supply strategy of biomass fuel.

Sensitivity Analysis: Change (%) of NPV @ 12%		
	10% Improvement	10% Deterioration
CER Price	2%	-2%
Power Sale Price	46%	-46%
Fuel Cost	27%	-27%
O&M Cost	5%	-5%

A 20 MW Thai biomass power plant was built in mid 2000s and originally designed to run on rice-husks from 20 neighbouring rice mills. The plant could only secure a one-year fuel supply contract with each mill. At the end of the year, each mill more than tripled the fuel price. Now switched to coal.

A 6 MW Indian biomass plant was dependent on local fuel spot market. Government tender for a large program caused existing plants to shut down as prices spiked in anticipation.

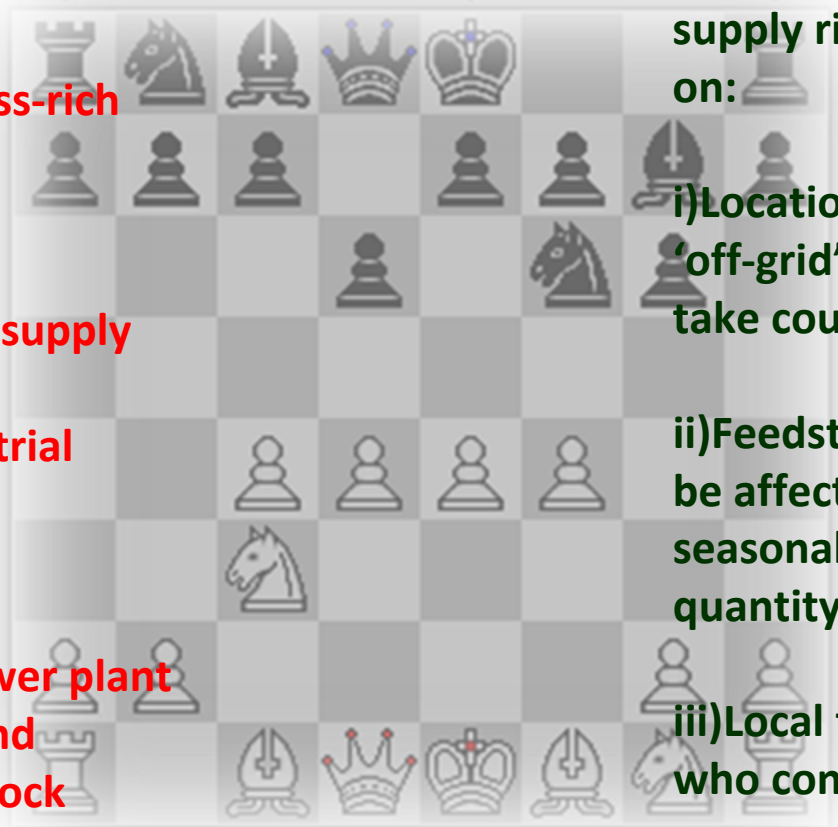
6 MW Indonesian biomass plant linked to neighboring agribusiness. When neighbor's business halved, fuel supply halved and operations halved.

A 12 MW Malaysian biomass plant targeted palm kernel as a fuel. During construction, fuel prices double because of alternative uses for the fuel arose. Had to switch fuel and increase capex an additional 8 million USD to different fuel with lower efficiency.

Fuel Strategies

Most biomass fuel strategies include three phases:

- **Identifying biomass-rich agricultural regions**
- **Securing biomass-supply contracts with both individual and industrial suppliers**
- **Customizing a power plant based on the type and availability of feedstock within the region**



This strategy exposes the developer to significant security of supply risk, given the dependence on:

i)Location, which is oftentimes 'off-grid' and without local off-take counterparties

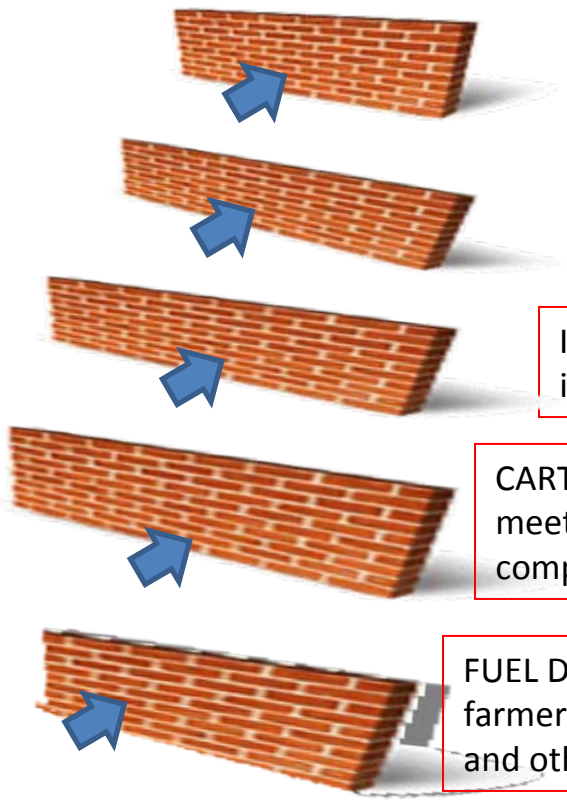
ii)Feedstock availability that may be affected by drought and seasonal variation in quality and quantity

iii)Local farmers and industries who control price and supply

iv)Specific fuel types and sources that may have alternative uses

Multiple Lines of Defense Strategy

Chinese Biomass Plant
Need: 250,000 tonnes/yr
Available: Harvest season - December to April: 692,000 tonnes
100,000 tonnes storage facility
40 dedicated staff



In "worst-case scenario", if someone somehow get a permit for a new plant and breaches all other defenses, it will take them more than 3 yrs to permit and commission the plant so at least limited period of returns.

GEOGRAPHIC: 50km radius in which no other biomass plants can be built (enough for over-supply).

INDUSTRIAL ESTATE: Plant is monopoly provider of steam to adjacent industrial park.

CARTEL: There is a provincial "cartel" of biomass plants in the province that meets regularly to control and punish any bad agencies/farmers/suppliers, compare prices, and support each other with fuel.

FUEL DIVERSITY – 3 layers from very different sources. "Local" sources from farmers, "offshore" sources of industrial biomass from outside province for wood and other industries. City backup support for municipal woodwaste.

1. Greenhouse Gas Market Basis

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A Fuel Shipping Strategy

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India – Replicable 12MW biomass plants

Project description

Plant will generate electricity and steam through the combustion of dry palm empty fruit bunches ("EFB"), other waste products from the palm oil industry, waste products from other agricultural industries and up to 25% coal if necessary. To ensure flexibility, the boilers have specifically been designed to combust a range of fuel-types at varying moisture contents. Biomass will be sourced from (i) neighbouring farms and mills and, for price and contingency reasons, (ii) Indonesia and Malaysia under various fuel-supply arrangements. Asia Renewables is equity holder in projects along with domestic and foreign partners.

The first power plant, is already at an advanced stage of development with all due-diligence, site preparation, land leasing, licensing and permitting, and power offtake agreements signed. A design specification and RFQ sent to shortlisted EPC companies and awaiting submissions. Financial close and ground-breaking for 2Q: 2010.

The second power plant is a 'brownfield' expansion to the first plant. All initial due-diligence, land leasing, site preparation and contract negotiations have been completed. The licensing and permitting, technical specification, project financing and power purchase agreements are currently being processed, and financial close for 3Q, 2010.

Other four plants: The land acquisition, licensing and permitting, technical specification, project financing and power purchase agreements are under processing. Financial close is targeted for 2010 to 2011.

Rationale

Will produce two primary and three possible secondary revenue streams:

- Sale of electricity to Provincial Board with favourable biomass electricity tariff (80GWh pa at US9.7c/kWh) and renewable energy policy;
- Sale of electricity to neighboring chemicals plant via captive offtake agreement at the prevailing biomass electricity tariff (10GWh pa at US9.7c/kWh);
- Potential generation of CERs for the substitution of non-renewable energy in the state grid (±65,000CERs pa per plant), positive exposure to carbon credit generation side;
- Potential excess steam sales to neighbouring industrial park; and
- Possible ash sales for fertilizer use.

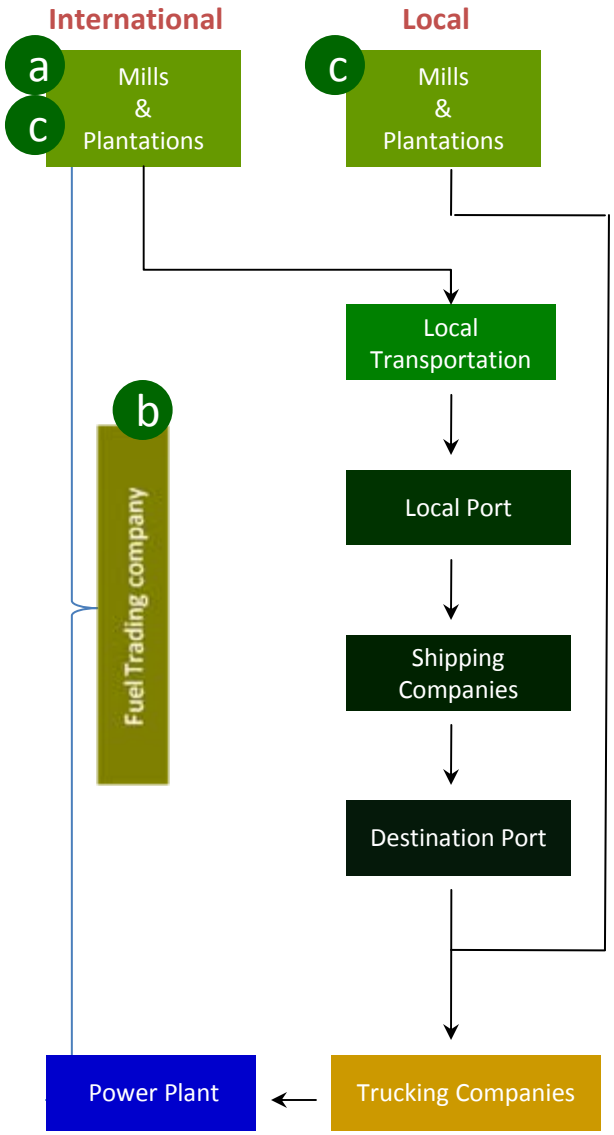
Local biomass down coastline.

Supply Chain Strategy

1. Provide Out-of-Region Supply Chain
   - Transship biomass from other ASEAN regions where conditions are not yet suitable for local plants
   - Hedge supply by scaling up demand simultaneously

2. Design Boilers and Fuel-handling Systems
   - to accommodate wide variety of fuel-types
   - e.g. wood-waste, soft coconut, peanut shells and coal

3. Locate Power Plant Near Major Break-bulk Port (<15km)
   - Increases geographic area from which feedstock can be sourced
   - Creates the option to sell electricity directly to the port and neighbouring industry

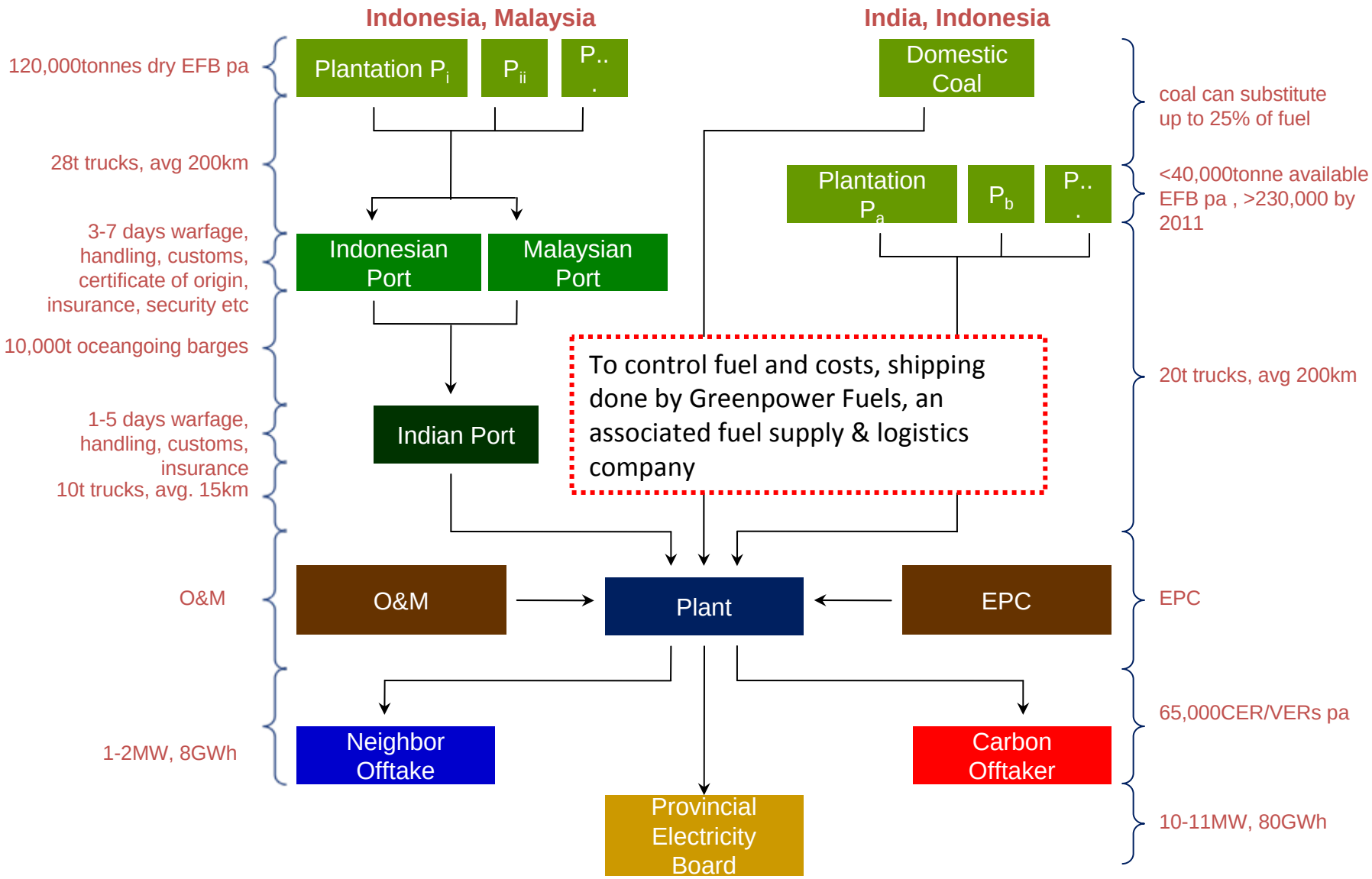


A. Long-term supply contract with dependable fuel suppliers

B. Form a joint venture with commodity trading firm

C. Invest directly in agricultural operations and businesses

Introduction to Biomass Fuel Supply



Supply Chain Samples ctd.


agricultural plantation


road transport to mills


mills


Agricultural waste


road transport to port


pre-port storage


origin Sea Port


sea transport


destination Sea Port


road transport to plant


storage


biomass power plant


local biomass (bagasse, peanut shells, wood-waste, cashewnut wood)

There are a variety of shipping companies that can be contracted to transport agricultural waste ASEAN to destination port.

Depending on the economies of scale and expected rate of biodegradation, agricultural waste could be shipped onboard ocean-going barges (10,000-12,000tonnes capacity) or larger break-bulk vessels (50,000tonnes capacity).

10 tonne trucks are popularly available in most areas of Asia.

4. Building on the Shipping Component

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Regionalizing a supply chain

India Plant is part of a 6 x 12 MW overall project (72 MW). Economies of scale and bargaining strength through additional plants.

Also possible back-end investment into fuel via upstream agribusinesses and plantations.

Next stage then open to extend platform back into Thailand, Indonesia, Malaysia, Philippines, etc. where favorable renewable tariffs and biomass supply exist.

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Final Thoughts

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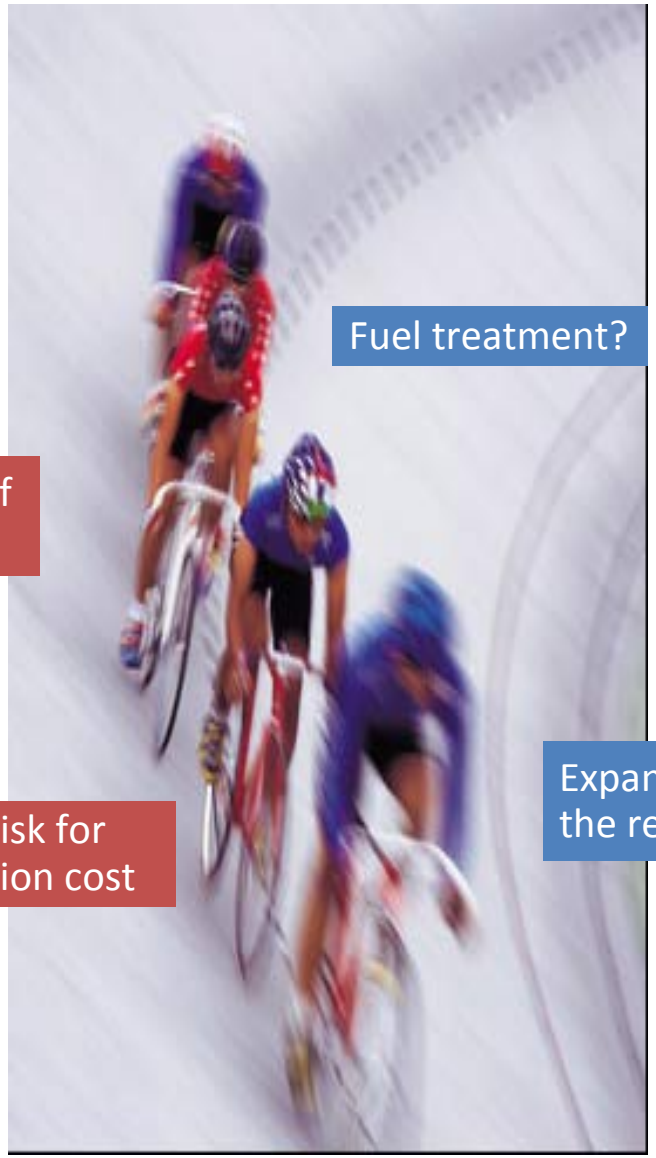

Effect on CDM?

Fuel treatment?

Biodegradation of biomass fuel

Expansion out of the region?

Oil price risk for transportation cost